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BALANCE PRACTICING MACHINE

BACKGROUND OF THE INVENTION

1. Field of Application

[0001] The invention relates to a balance practicing machine that provides a swinging motion to a person sitting on the machine in order to provide balance practice and exercise.

2. Description of the Related Art

[0002] The related art includes a type of conventional balance practicing machine which is constructed in the shape of a horse and equipped with six power sources that generate six different movements. An example of such a conventional balance practicing machine is described in Japanese Kokou Patent No. H6-65350. These six movements consist of repetitive linear motions in the fore-aft, right-left, and vertical directions, and repetitive pivoting motions around longitudinally, transversely, and vertically oriented shafts. These motions combine to form a compound swinging movement comprised of six separately controllable movements.

[0003] Another type of conventional balance practicing machine is shown in Figures 7 through 9. An example of this type of conventional balance practicing machine is described in Japanese Kokai (laid open) Patent 2001-286578. This machine is equipped with seat 2 on which a person sits, drive assembly 3 which imparts a swinging motion to seat 2, main shaft 30 of motor 10a that extends in the 'A' and 'B' directions, and output shafts 12a and 12b that provide power transmission to move seat 2 with a repetitive linear motion in the fore-aft X direction, a repetitive pivoting motion in a direction around transversely oriented shaft 7, and a repetitive pivoting motion in a direction around longitudinally oriented shaft 9. As Figure 7 illustrates, torque supplied through output shaft 12a, which extends from one side of motor 10a, is transferred from gear 31 to gear 32, and rotates shaft 33 to which first

crank 34 is attached to one end thereof. The rotation of first crank 34 is converted, through first rod 35, into concurrent forward and rearward pivoting motions of first link 36 and second link 38 around pivot pins 37 and 39, respectively, thus imparting forward and rearward motions to seat 2, through seat base 4, along with changes in the inclination of the upper surface of seat 2. The upper end of second link 38 is pivotably attached to seat base 4 through ball joint 71 so as to form a movable link there between, and the lower end is pivotably attached to base member 8 through support plate 70. The torque supplied by output shaft 12b, which extends from the other side of motor 10a, is transferred from gear 40 to gear 41 (Figure 8) to rotate second crank 43 which is connected to one end of shaft 42 (Figure 9). The rotation of second crank 43 imparts a repetitive pivoting motion to seat base 4 and seat 2, through second rod 44, in a direction around longitudinally oriented shaft 9.

[0004] Because the balance practicing machine described in Japanese Kokou Patent No. H6-65350 is equipped with six separately controlled power sources, the timing, speed, and operating range of each power source must be individually controlled, thus making for an extremely complex control system. Moreover, the use of six power sources increases both the cost and size of the balance practicing machine.

[0005] The balance practicing machine described in Japanese Kokai (laid open) Patent 2001-286578 incorporates output shaft 12 that extends in two opposing directions from motor 10a, thus requiring that motor 10a be installed horizontally. This structure creates a problem in that a large amount of space must be provided on the horizontal plane to accommodate the bi-direction extension of output shaft 12, and that drive assembly 3 be made to relatively large dimensions.

SUMMARY OF THE INVENTION

[0006] The invention, improving on the two conventional structures described above, proposes a balance practicing machine that employs a power source from which a rotating output shaft extends from one side, and that generates movements of the seat in the form of a repetitive linear motion in the fore-aft direction, a repetitive pivoting motion around a longitudinal shaft, and a repetitive pivoting motion around transverse shafts. The invention is thus able to offer the advantages of a simple control system, reduced cost, and a smaller balance practicing machine that requires less space for the drive assembly.

[0007] In order to improve the devices of the prior art, the present invention proposes a balance practicing machine comprising a seat on which a person sits, and a drive assembly that imparts a swinging motion to the seat. A seat base, to which the seat is fixedly attached, is pivotably supported, through connector links, by transverse shafts on an active frame so as to allow a repetitive pivoting movement of the seat base around transverse shafts. The active frame is pivotably supported by a longitudinal shaft on a base member so as to allow the repetitive pivoting movement of the active frame around the longitudinal shaft.

[0008] The drive assembly is equipped with a power source from which an output shaft extends from one side, and a transmission which converts the rotational torque from the output shaft into three movements of the seat base, thus imparting to the seat a repetitive linear motion in the fore-aft X direction, a repetitive pivoting motion around the transverse shafts, and a repetitive pivoting motion around the longitudinal shaft.

[0009] This construction is thus able to provide a body balancing practice and exercise function by moving the seat with fore-aft, left-right, and vertical swinging motions as three movements that include a repetitive linear motion in the fore-aft X

direction, a repetitive pivoting motion around the transverse shafts, and a repetitive pivoting motion around the longitudinal shaft.

[0010] Moreover, the use of only one power source eliminates the need for multiple power sources, and because the output shaft extends from only one side of the power source, the drive assembly can be made to more compact dimensions and installed within a smaller space as compared to that required by a conventional drive assembly.

[0011] The transmission includes a first sub-transmission that generates a repetitive linear motion in the fore-aft X direction as well as a repetitive pivoting motion around the transverse shafts. The first sub-transmission includes a first shaft which is rotatably supported by the seat base and connected to the output shaft through a first gear, an eccentric crank which is eccentrically connected to one end of the first shaft, and an arm link of which one end is connected to an eccentric crank and the other end to a connector link.

[0012] The transmission also includes a second sub-transmission that generates a repetitive pivoting motion around the longitudinal shaft. The second sub-transmission includes a second shaft which is rotatably supported by the seat base and connected to the first shaft through a second gear, and an eccentric rod of which one end is eccentrically connected to one end of the second shaft, and the other end pivotably connected to the base member.

[0013] The first and second sub-transmissions offer the advantages of few required components, easy assembly, and reduced size.

[0014] An aspect of the present invention provides a balance practicing machine having a seat and a drive assembly that imparts a swinging motion in a longitudinal direction to the seat, the balance practicing machine including a seat base attached to the seat; a plurality of transverse shafts provided on an active frame; a plurality of

connector links, each connector link pivotable on one of the transverse shafts and on the seat base so as to provide swinging motion to the seat base around the transverse shafts; a longitudinal shaft provided on a base member and pivotably supporting the active frame so as to provide a pivoting motion to the active frame around the longitudinal shaft; an output shaft provided in the drive assembly that extends from one side of a power source; and a transmission that converts torque from the output shaft into three movements of the seat through the seat base, in the form of a linear motion in a longitudinal direction, a pivoting motion around the transverse shafts, and a pivoting motion around the longitudinal shaft. According to a further aspect of the present invention, the transmission includes a first sub-transmission that generates a linear motion in the longitudinal direction and a pivoting motion around the transverse shafts, the first sub-transmission including a first shaft rotatably supported and connected to the output shaft through a first gear, an eccentric crank eccentrically connected on one end of the first shaft, and an arm link having one end connected to the eccentric crank and the other end to a connector link; and a second sub-transmission that generates a pivoting motion around the longitudinal shaft, the second sub-transmission including a second shaft rotatably supported and connected to the first shaft through a second gear, and an eccentric rod having one end eccentrically connected to one end of the second shaft and the other end pivotably connected to the base member. Further, the plurality of connector links may include a pair of connector links including a first connector link pivotable on a forward transverse shaft and a second connector link pivotable on a rearward transverse shaft. The first connector link and the second connector link may be provided in positions nonparallel to each other, so that swinging motion in the longitudinal direction is imparted to the seat base; and the pair of connector links, the seat base, and the base member substantially form a trapezoid. The drive assembly may be housed

substantially within the seat. The seat base may move forwardly and rearwardly in the longitudinal direction so that the seat base is intermittently parallel and nonparallel to the base member during the swinging motion of the seat base.

[0015] A further aspect of the present invention provides a balance practicing machine having a seat that supports an operator, the balance practicing machine including a pedestal supporting the seat on top of the pedestal; and a drive assembly that provides a swinging motion in a first direction to the seat and a pivoting motion in a second transverse direction to the seat; wherein the drive assembly is housed substantially within the seat. Further, the seat may be substantially shaped like a saddle. According to a further aspect of the invention, the drive assembly includes a pair of connector links including a first connector link pivotable on a forward transverse shaft and a second connector link pivotable on a rearward transverse shaft. Further, the first connector link and the second connector link may be provided in positions nonparallel to each other, so that swinging motion in the longitudinal direction is imparted to the seat base; the pair of connector links, a seat base, and a base member may substantially form a trapezoid; and the seat base moves forwardly and rearwardly in the longitudinal direction so that the seat base is intermittently parallel and nonparallel to the base member during the swinging motion of the seat base.

[0016] A further aspect of the present invention provides a balance practicing machine having a seat and a drive assembly that imparts a swinging motion in a longitudinal direction to the seat, the balance practicing machine including a seat base attached to the seat; a plurality of transverse shafts provided on an active frame; a plurality of connector links, each the connector link pivotable on one of the transverse shafts and on the seat base so as to provide swinging motion to the seat base around the transverse shafts; a longitudinal shaft provided on a base member and

pivotably supporting the active frame so as to provide a pivoting motion to the active frame around the longitudinal shaft; a single power source; and a transmission that converts torque from the single power source into three movements of the seat through the seat base, in the form of a linear motion in a longitudinal direction, a pivoting motion around the transverse shafts, and a pivoting motion around the longitudinal shaft. Further, the single power source may include an output shaft provided in the drive assembly that extends from one side of the single power source; wherein the transmission converts torque from the output shaft into the three movements of the seat through the seat base, in the form of a linear motion in a longitudinal direction, a pivoting motion around the transverse shafts, and a pivoting motion around the longitudinal shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above, and other objects, features and advantages of the present invention will be made apparent from the following description of the preferred embodiments, given as nonlimiting examples, with reference to the accompanying drawings in which:

Figure 1 is a side view of the balance practicing machine according to an embodiment of the present invention;

Figure 2 is an enlarged side view illustrating the manner in which the seat of the balance practicing machine of the embodiment of Figure 1 view moves with a repetitive linear motion in the longitudinal direction and a repetitive pivoting motion around the transverse shafts;

Figure 3 is a top view of the drive assembly of the balance practicing machine of the embodiment of Figure 1;

Figure 4 is an enlarged front view illustrating the manner in which the seat pivots around the longitudinal shaft of the balance practicing machine of the embodiment of Figure 1;

Figure 5a is a perspective view of the balance practicing machine of the embodiment of Figure 1 in use;

Figure 5b is a diagram illustrating the linear and swinging movements of the seat of the balance practicing machine of the embodiment of Figure 1;

Figure 6 is a block diagram of the drive assembly of the balance practicing machine of the embodiment of Figure 1;

Figure 7 is a vertical cross sectional view of a conventional balance practicing machine as viewed from the right side thereof;

Figure 8 is a vertical cross sectional view of a conventional balance practicing machine as viewed from the left side thereof; and

Figure 9 is a vertical cross sectional view of a conventional balance practicing machine as viewed from the front thereof.

DETAILED DESCRIPTION OF THE INVENTION

[0018] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description is taken with the drawings making apparent to those skilled in the art how the forms of the present invention may be embodied in practice.

[0019] The following will explain an embodiment of the present invention with reference to the attached figures. The present invention includes a balance practicing

machine 1 which, as shown in Figures 1 through 4, is constructed in the form of a seat 2 on which a persons sits, a pedestal 50 which supports the seat 2, and a drive assembly 3 that imparts a swinging motion to the seat 2.

[0020] As shown in Figure 2, seat base 4, which is fixedly attached to the lower surface of seat 2, is supported by active frame 6, through a pair of left and right side connector links 5 in a manner that allows seat base 4 to swing in the fore-aft or longitudinal direction with respect to active frame 6. Active frame 6 is supported by base member 8 so as to be pivotable to the right and left thereon, and transmission 13 is provided between seat 2 and active frame 6. The pair of right and left connector links 5 each include a front link 5a and rear link 5b. The upper ends of front links 5a are pivotably attached to the front edge of seat base 4 through upper pivot pins 2a, and the lower ends of front links 5a are pivotably attached to the front edge of side plate 16 of active frame 6 through lower pivot pins 7a. The upper ends of rear links 5b are pivotably attached to the rear edge of seat base 4 through upper pivot pins 2b, and the lower ends are pivotably attached to the rear edge of side plate 16 of active frame 6 through lower pivot pins 7b. Lower front and rear pivot pins 7a and 7b are each part of front and rear transverse shafts 7 that support the pivoting movement of connector links 5 around the transverse axes or shafts 7, which extend in the left and right Y direction. Figure 2 shows a first position of the seat base 4 in solid lines (the right position in Figure 2) and a second position of the seat base 4 in dotted lines (the left position in Figure 2). As shown in figure 2, each pair of connector links 5a, 5b are not parallel to each other. That is, connector link 5a is not parallel to connector link 5b. As a result, a repetitive swinging motion (*i.e.*, linear motion combined with pivoting motion) is obtained in the form of seat base 4 swinging around transverse shafts 7 in the M direction shown in Figure 2. Additionally, as shown in figure 2, the swinging motion of the base 4 around the transverse shafts 7 provides movement of

the seat base 4 such that the seat base 4 does not remain parallel to the base member 8.

[0021] As illustrated in Figures 2 and 4, pivot support plates 24 are located at the front end and rear end of base member 8 and disposed along the longitudinal X direction. Connector plates 25 are provided as vertical members of the front end and rear end portions of active frame 6, align along the longitudinal X direction in opposition to pivot support plates 24, and are pivotably joined to longitudinal shaft 9 so as to be able to pivot against support plates 24. The front and rear ends of active frame 6 are pivotably supported along the center of base member 8 by longitudinal shaft 9, thereby allowing seat base 4 to repetitively pivot around longitudinal shaft 9 in direction N as shown in Figure 4.

[0022] Drive assembly 3 incorporates power source 10 in the form of a single motor 10a from which output shaft 12 extends outward from one side, and transmission 13 that converts the rotational torque from output shaft 12 into three movements of seat 2 through seat base 4. The movements of the seat include (1) a repetitive fore-aft longitudinal linear motion along the X direction; (2) a repetitive pivoting motion around transverse shafts 7; and (3) a repetitive pivoting motion around longitudinal shaft 9. Together, the (1) repetitive fore-aft longitudinal linear motion along the X direction plus the (2) repetitive pivoting motion around transverse shafts 7 provide the fore-aft longitudinal swinging motion of the present invention. The fore-aft longitudinal swinging motion of the present invention is a mixed motion formed by linear motion combined with pivoting motion. In this embodiment, motor 10a is provided vertically on base member 8 with output shaft 12 extending in the upward direction.

[0023] Transmission 13 is constructed in the form of first sub-transmission 13a that generates the repetitive linear motion in the fore-aft longitudinal X direction and the

repetitive pivoting motion around transverse shafts 7, and second sub-transmission 13b that generates the repetitive pivoting motion around longitudinal shaft 9. As shown in Figures 2, 3, and 6, first sub-transmission 13a includes first shaft 17 that is joined to output shaft 12 through first gear 14, eccentric crank 19 connected to an eccentric point on one end of first shaft 17, and arm link 20 of which one end is connected to pivot pin 5c on connector link 5a, and the other to eccentric crank 19. Each end of first shaft 17 is rotatably supported by the machine. The eccentric rotation of eccentric crank 19, relative to the rotation of first shaft 17, imparts a repetitive movement to front link 5a, through arm link 20, along the fore-aft longitudinal X direction. This movement is transferred to seat base 4, thus driving seat 2 with a repetitive swinging motion in the direction indicated by arrow M in Figures 1 and 2.

[0024] Second sub-transmission 13b, as shown in figures 3, 4, and 6, includes second shaft 18 that is connected to first shaft 17 through second gear 15, and eccentric rod 21 of which one end is eccentrically joined to one end of second shaft 18, and the other end pivotably joined to base member 8. Both ends of second shaft 18 are rotatably supported by the machine. Eccentric rod 21 may be located on either the right or left side of seat base 4 with upper end 21a eccentrically joined to one end of second shaft 18 through pivot pin 62 as shown in Figure 4, and lower end 21b pivotably joined to pivot pin 61 which is anchored by L-shaped connecting bracket 60 which is, in turn, fixedly attached to base member 8. The rotation of second shaft 18 imparts an eccentric rotational movement to the upper end of eccentric rod 21, thus conveying a swinging motion to seat 2, through seat base 4, in the direction of arrow N shown in Figure 4.

[0025] A structure is thus formed whereby the rotation of output shaft 12, which extends from one side of motor 10a, rotationally drives first shaft 17 through the

meshing of motor worm gear 11 with first gear 14, and second shaft 18 through the meshing of drive gear 22 (on first shaft 17) with second gear 15. Eccentric crank 19, which is provided on one end of first shaft 17, rotates along an eccentric orbit powered by the rotation of first shaft 17, thereby imparting a longitudinal pivoting motion in the X direction, through arm link 20, to front link 5a around front transverse shaft 7a. At the same time, rear link 5b pivots with the same motion around rear transverse shaft 7b, thus imparting a repetitive longitudinal swinging motion to seat 2, through seat base 4, in the M direction. Moreover, the rotation of second shaft 18 drives the top end of eccentric rod 21 through an eccentric orbit that imparts a repetitive pivoting motion to seat 2, through seat base 4, around longitudinal shaft 9.

[0026] As described above, seat 2 is driven in longitudinal X, transverse Y, and vertical Z directions, and swings in the θX and θY directions as shown in Figure 5b, thus providing a balance practicing and exercise function for the person sitting thereon. Moreover, as a result of a structure that allows a single motor 10a to generate three movements of the seat, the balance practicing machine requires fewer motors, the control system is simplified, cost reduced, and the machine can be made to smaller dimensions. Furthermore, motor 10a may be installed in a vertical orientation because output shaft 12 extends from only one side of motor 10a. In other words, while a conventional balance practicing machine requires that motor 10a be disposed horizontally to accommodate output shafts 12a and 12b that extend from opposite sides of the motor (Figure 7), the present invention provides for a single motor output shaft 12 that extends only from one side of motor 10a, thus allowing motor 10a to be positioned in a vertical orientation. As shown in Figure 1, this configuration allows drive assembly 3, which includes motor 10a, to be made to smaller dimensions to occupy less space. Also, because in the present invention the drive assembly 3 can be housed within seat 2, the riding experience can be simulated

more accurately than with conventional balance practicing machines. The position of the drive assembly 3 is one of the improvements of the present invention over the conventional machine of the prior art, in which the drive assembly is positioned below the seat. In the conventional machine, the position of the seat is higher that of the present invention. Accordingly, the distance between the position of the user and the position of the drive assembly 3 in the balance practicing machine of the present invention is smaller than that of the conventional machine, so that the user or target and the drive assembly 3 are closer together. This shortening of the distance between the position of the user sitting on the balance practicing machine and the drive assembly 3 results in an improvement in accuracy of the motion for balance practicing, so that the operation of the machine is easier to control.

[0027] Moreover, the number of parts required to construct the balance practicing machine of the present invention is reduced because of the structure of first sub-transmission 13a which includes first shaft 17, eccentric crank 19, and arm link 20; and the structure of second sub-transmission 13b which includes second shaft 18 and eccentric rod 21. Furthermore, first sub-transmission 13a can be easily assembled by simply connecting eccentric crank 19 to first shaft 17 which is rotatably supported by seat base 4, and attaching connector link 5 to eccentric crank 19 through arm link 20. Second sub-transmission 13a can also be easily assembled by eccentrically connecting top end 21a of eccentric rod 21 to second shaft 18 which is rotatably supported by seat base 4, and pivotably connecting bottom end 21b to base member 8. This structure provides for easy assembly while reducing the cost and size of drive assembly 3 by reducing the number of motors from three to one.

[0028] Although the invention has been described with reference to an exemplary embodiment, it is understood that the words that have been used are words of description and illustration, rather than words of limitation. Changes may be made

within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the invention in its aspects. Although the invention has been described with reference to particular means, materials and embodiments, the invention is not intended to be limited to the particulars disclosed. Rather, the invention extends to all functionally equivalent structures, methods, and uses such as are within the scope of the appended claims.

[0029] The present disclosure relates to subject matter contained in priority Japanese Application No. 2003-010290, filed on January 17, 2003, which is herein expressly incorporated by reference in its entirety.